THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF A MANUFACTURING PROCEDURE FOR LOW-LITHIUM, LOW-URANIUM CONTENT FILTER PAPER

Project 3101-1

Report Seventeen

A Status Report

to

DEPARTMENT OF THE AIR FORCE
1155th TECHNICAL OPERATIONS SQUADRON (HQ. COMD.)
McCLELLAN AFB, CALIFORNIA

March 17, 1975

TABLE OF CONTENTS

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SUMMARY

The purification of 100-sheet lots of 19-inch squares of IPC-1478, Series N, paper was continued. Data indicated that the lowest levels of lithium (approximately 1 ng Li/g) thus far were favored by (a) extending the time of the second leaching cycle to 8 days, (b) increasing the volume of final wash water, and (c) applying the Kronisol by a polyethylene bottle applicator instead of a paint sprayer.

Leaching intact rolls of Series N paper appeared to be practical, and produced paper (without Kronisol) at <2 ng Li/g.

Controlled leaching of Series N paper with water demonstrated that >80% of the lithium was readily accessible to purified water.

Series N paper was somewhat less efficiently purified in a capillary movement technique than in percolation techniques. Glass equipment did not appear to supply lithium to the system.

A series of sets of handsheets was made in tap water (Appleton city water, pH 9.6, 11.1 ng Li/ml) from Hercules PS-57 pulp and from purified pulp. The results demonstrated that approximately 90% of the lithium in the newly formed, wet sheet may be washed out with purified water applied before couching the sheet. There was some added advantage in using wash water at pH 9 (ammonium carbonate), and in the use of purified pulp in purified water.

Fines were loosened from Series N paper (scrim removed) in a water slurry under vigorous stirring. The fines were collected on circles of purified pulp and analyzed. The data showed that fines (a) appear to hold large amounts of lithium (>100 ng Li/g fines) compared with the residual paper (<3 ng Li/g paper). However, the contribution of the fines when retained by the finished paper was probably <20% of the lithium present.

Air filtration tests on selected samples were run at Knowlton Brothers in the USAF tester under the supervision of Dr. Grant Rauscher. The results showed that the purification processes for IPC-1478 paper caused little if any changes in the filtration properties of the paper.

RESULTS AND DISCUSSION

PURIFICATION OF SERIES N PAPER, 19-INCH SQUARES

The purified Series N paper in Lots 376 and 378 retained larger amounts of lithium than expected (1). The increase appeared to be due to the step in which Kronisol was added, and the paint sprayer was suspected as a possible source of the contamination. As a consequence, the application of Kronisol was accomplished by means of a 500-ml polyethylene (PE) bottle bearing a narrow perforated zone from top-to-bottom in the bottle wall. Kronisol was applied from the bottle by placing the perforated zone in contact with the paper, forcing the Kronisol from the bottle under light hand-pressure and distributing the oil over the sheet through quick, even strokes. Each sheet was monitored by weighing. With a little practice, the amount of Kronisol was held closely to 30% based on the weight of the untreated, airdry paper.

Analytical data, summarized in Table I, may represent an approach toward a limit of approximately 1 ng Li/g. Sample 426, especially, is believed to show the added advantage of the extended time for the leaching steps, 8 days in contrast to 5 hours, and a larger volume of wash water. Also, the application of Kronisol by means of the PE bottle may have reduced the contamination by lithium in contrast to the application by paint sprayer. Additional lots of paper may provide further insight into the efficiency of the procedure.

PURIFICATION OF SERIES N PAPER IN INTACT ROLLS

Rolls of Series N paper were provided by the laboratory at McClellan AFB. Each roll was 10 inches by 80 feet and was wound on an inert core of

TABLE I

ANALYSIS OF PURIFIED, IPC-1478 PAPER, SERIES N, IN 19-INCH SQUARES[a]

Sample No. 3101-		Uranium 8/5	Uranium ng/g	Lithium, ng/g	Remarks	
IPC-1478 Paper, Series N, purified by leaching through 2 cycles; 30% Kronisol applied by perforated polyethylene bottle applicator.						
372	A	143	0.149	1.36		
	B	132	0.126	1.54	1st cycle (5 hours)	From
406		120	0.148	1.16	2nd cycle (5 hours)	Roll
409		140	0.122	1.48	30% Kronisol added	No. 11-4
374		137	0.137	(44.1, 40.1)[b]	1st cycle (5 hours)	From
410		135	0.154	1.20	2nd cycle (5 hours)	Roll
425		138	0.148	1.19	30% Kronisol added	No. 11-1
386		141	0.118	1.57	1st cycle (5 hours)	From
423		126	0.064	0.94	2nd cycle (8 days)	Roll
426		141	0.062	1.11	30% Kronisol added	No. 11-5

[a]Analytical data were received by letters dated February 5 and 19, 1975, from Jack Phelps to E. E. Dickey.

[b]Error suspected in analysis; sample may be reanalyzed.

3-1/2-inch PVC sewer pipe. The rolls were leached in two cycles by the percolation of hydrofluoric acid and ammonium carbonate, and thorough washing with water. The data listed in Table II for Samples 383 and 384 show that the purification method may be satisfactory for intact rolls when a suitable dryer is available. No further work has been planned with intact rolls.

LIMITED LEACHING OF SERIES N PAPER

In order to explore the accessibility of lithium, a stack of 100 sheets of Series N paper was leached with deionized water by percolation and capillary action. The water was added carefully in small portions until the stack was

TABLE II

ANALYSIS OF SAMPLES FROM MISCELLANEOUS EXPERIMENTS, AND PROCESS WATER[a]

Sample No. 3101-	Uranium 8/5	Uranium ng/g	Lithium, ng/g	Remarks	
IPC-1478 paper, Series N, purified in the roll by leaching with 0.1M hydrofluoric acid and 0.1M ammonium carbonate.					
380	--	--	--	First cycle	Roll No. 1
381	--	--	--	Second cycle [Note: These samples are available for analysis upon request]	
383	133	0.143	1.85	First cycle	Roll No. 2
384	141	0.107	1.29	Second cycle	
IPC-1478 paper, Series N, 17-cm squares, stack of 100, leached by percolation with 1300 ml of deionized water; dried and packaged in sets of four.					
385 A			3.32	Sheets 1-4	[Note: The remainder of this series is available for analysis upon request]
F			8.56	Sheets 21-24	
L			17.3	Sheets 45-48	
U			44.2	Sheets 81-84	
Y			167	Sheets 97-100	
IPC-1478 paper, Series N, strips 24-cm wide by 110-cm long, leached by capillary migration of water and ammonium carbonate.					
399			2.52	In PE trough; water only	
400			--	In glass trough; water only [Available upon request]	
401			2.87	In PE trough; water and amm. carbonate	
402			2.35	In glass trough; water and amm. carbonate	

[a]Analytical data were received by letter dated February 5, 1975, from Jack Phelps to E. E. Dickey.

just wet. The stack was separated into sets of four sheets each, and dried in a stream of filtered air. The data in Table II, Samples 385A to Y, show that >80% of the lithium was removed from the top set and was carried into the bottom set in a relatively high concentration, >8 times the original (20 ng Li/g). Most of the lithium appeared to be available in a water-soluble form and was readily washed from the fiber. The distribution from top to bottom, 385A to Y, appeared to be consistent with the phenomenon of diffusion as encountered in the washing of chemical pulps. No additional experiments of this type have been planned.

ATTEMPTED PURIFICATION OF SERIES N PAPER BY CAPILLARY MIGRATION OF THE LEACHING AGENTS

In order to test the efficiency of lithium removal when the leaching agents moved through the sheet by capillary migration, strips of Series N paper were placed in an apparatus commonly used for paper chromatography. One trough was polyethylene (PE) and neither the paper nor the leaching agents came into contact with glass. The other trough was glass as supplied with such equipment. As shown in Table II, Samples 399, 401, and 402, the efficiency was high but somewhat less than that of other procedures (compare with Samples 406, 410, and 423 in Table I). It seems evident that the all-glass apparatus was not a source of lithium contamination although such equipment could not be used for the hydrofluoric acid treatment.

No further experiments have been planned for this technique.

HANDSHEETS MADE IN TAP WATER AND IN DEIONIZED WATER

Both Hercules cotton linter pulp, PS-57, and purified pulp No. 341 were made into handsheets using tap water (Appleton city water) at pH 9 as delivered in the water mains. The lithium content was 11 ng/ml (390). As shown in Table III the handsheets, which were dried at approximately 25% consistency, retained >40 ng Li/g of which at least 30 ng was due to process water dried on the sheet. This premise was reinforced by Samples 394 and 396 which were made in tap water and rinsed on the sheet mold with deionized water and with water adjusted to pH 9 with ammonium carbonate, respectively. The removal of 90% of the lithium by washing with purified water was consistent with the results of the limited leaching experiment, Samples 385A to Y, Table II.

Based on the results of these handsheet studies, a rinsing of the sheet on the wire of the fourdrinier machine with purified (deionized or distilled) water might reduce significantly the level of lithium in commercially-made IPC-1478 paper. The use of purified pulp in deionized water (407) showed some advantage over the handsheets made from purified pulp in tap water and rinsed with purified water (403) or ammonium carbonate (404).

No further experiments along these lines have been planned.

RECOVERY OF FINES[1] FROM SERIES N PAPER

Although the role of fines in the retention of lithium by IPC-1478 paper had been explored briefly, both at the Institute (2) and at McClellan

[1] "Fines" are defined here arbitrarily as particles which will pass through a coarse mesh (50-60) screen but are collected on a suitable fiber mat. The particles may be very short and broken pieces of fibers along with unknown materials which have accumulated during the processing of the pulp and paper.

Department of the Air Force
1155th Technical Operations Squadron (Hq. Comd.)
McClellan AFB, California
Project 3101-1

TABLE III

HANDSHEETS MADE IN TAP WATER AND IN DEIONIZED WATER[a]

Sample No. 3101-	Uranium 8/5	Uranium ng/g	Lithium, ng/g	Description
393	127	1.35	41.1	Handsheets made from Hercules pulp, PS-57, in 6 liters of tap water (Appleton city water, pH 9.5)
394	121	0.71	5.55	Handsheets, same as 393 except that each handsheet was rinsed on the mold with 2 x 200 ml of deionized water
396	119	0.86	4.28	Handsheets, same as 393 except that each handsheet was rinsed on the mold with deionized water at pH 9 (ammonium carbonate)
397	127	1.02	44.4	Handsheets made from purified pulp No. 341 (see Report Fourteen, p. 28), in 6 liters of tap water (Appleton city water, pH 9.5)
403	127	0.27	4.98	Handsheets, same as 397 except that each handsheet was rinsed on the mold with 2 x 200 ml of deionized water
404	118	0.47	3.67	Handsheets, same as 397 except that each handsheet was rinsed on the mold with deionized water at pH 9 (ammonium carbonate)
407	133	0.11	3.07	Handsheets, same as 397 except that deionized water at pH 9 only was used in making the handsheets
405	117	0.14	0.58	Hercules pulp, PS-57, purified by leaching with hydrofluoric acid and ammonium carbonate, one cycle; used for couching handsheets in Sample 407
390	138	0.149 ng/ml	11.1 ng/ml	Appleton city water, pH 9.6
391	116	1.29	2.36	Hercules pulp, PS-57; control [same as 3101-001, Report Seven, p. 7]
341 C	119	0.041	0.26	Purified Hercules pulp (PS-57) [see Project 3101, Report Fourteen, p. 28]

[a]Analytical data were received by letter dated February 5, 1975, from Jack Phelps to E. E. Dickey.

AFB, MCL-C (3), further work seemed necessary. The chief question was: Is lithium bound in the fines in an inaccessible or water-insoluble form as compared with that in the pulp?

In the Series 412 to 414, 421, and 422, shown in Table IV, fines were loosened from Series N paper (minus the scrim) by stirring in a British Disintegrator[2]. The fines were drained from the pulp by pouring the slurry into a plastic funnel fitted with a plastic screen. The "white water" was then filtered through a tared circle of purified PS-57 pulp. The amount of fines was determined gravimetrically.

To determine the amount of lithium associated with the fines, only (and not with the pulp circle) an assumption was made that the lithium on the pulp circle fibers was the same as found on the pulp pad from which the fines had been dislodged. Based on this assumption, the amount of lithium in the fines was estimated. As an example, the amount of lithium in the fines from Sample 298 was calculated from the data in Table IV:

$$\frac{\left[\begin{matrix}\text{av. wt. (g)} \\ \text{of Circle 298}\end{matrix}\right] \times \left[\left(\begin{matrix}\text{av. Li content} \\ \text{of 298}\end{matrix}\right) - \left(\begin{matrix}\text{av. Li content} \\ \text{of 299}\end{matrix}\right)\right]}{[\text{wt (g) estimated of fines in 298}]} = \text{Li content of fines, only,}$$

or $$\frac{5.351\ (2.71 - 1.29)}{0.20} = 38 \text{ ng Li/g of fines, only.}$$

The corresponding values for 303, 413, and 421 show that, compared with pulp from the same system, a disproportionately large amount of lithium is retained by the fines. However, the amount of lithium carried in the fines would

[2] For a description see TAPPI Standard Method T 205 os-71 (TAPPI, 1 Dunwoody Park, Atlanta, GA 30341).

Department of the Air Force
1155th Technical Operations Squadron (Hq. Comd.)
McClellan AFB, California
Project 3101-1

TABLE IV

COLLECTION AND ANALYSIS OF FINES FROM PS-57 PULP AND IPC-1478 PAPER, SERIES N

Sample No. 3101-		Weight Analyzed, g	Uranium 8/5	Uranium ng/g	Lithium, ng/g	Remarks
Hercules Pulp, PS-57, was dispersed in deionized water, the slurry was poured into a plastic funnel (no filter paper was used), the "white water" was collected and then filtered on a circle of the pulp in the dry-lapped form. Each circle carried the fines from 60 g of pulp.[a]						
298	A	5.460			2.66	Circles No. 2, 3 bearing
	B	5.243			2.75	fines (0.20 g estimated)
		Av. 5.351			Av. 2.71	from pulp Samples 299 and 300
Lithium content of fines (298)					38	By approximation[b]
299	A				1.25	Pulp pads from which fines
	B				1.32	298 were recovered
					Av. 1.29	
303	A	5.111			2.80	Circles No. 5, 6 bearing
	B	5.559			3.02	fines (0.20 g estimated)
		Av. 5.335			Av. 2.91	from pulp Samples 304, 305
Lithium content of fines (303)					43	By approximation[b]
304	A				1.28	Pulp pads from which fines
	B				1.32	304 were recovered
					Av. 1.30	
IPC-1478 Paper, Series N, scrim removed, dispersed in deionized water, slurry poured on a plastic screen. The "white water" filtered on tared circle of purified Hercules PS-57 pulp, No. 341. Five lots processed; water was recycled.						
413		5.04	132	0.88	7.33	Fines, 0.183 g, from 414 on 4.86 g purified pulp
Lithium content of fines (413), only					125	Calculated[c] — 1st Lot
414		13.8	130	1.05	2.79	54 g Pulp from Series N paper after fines (413) removed
421		5.22	132	1.08	14.4	Fines, 0.175 g, from 422 on 5.04 g purified pulp
Lithium content of fines (421), only					107	Calculated[c] — 5th Lot
422		14.0	124	0.66	10.8	55 g Pulp from Series N paper after fines (421) removed
412		200 ml	133	0.0054	2.10 ng/ml	Filtrate, 3.8 liters, at end of fifth lot of fines (421).

[a] For details of this procedure see Project 3101, Report Fourteen, p. 47.
[b] The lithium contents were approximated by assuming that the weight of fines was 0.200 g on each circle, and that the lithium not held in the fines was the same as that in the pulp samples, 299 and 304, respectively.
[c] The lithium contents were calculated on the assumption that the lithium not held in the fines was the same as that in the pulp samples, 414 and 422, respectively.

have added <20% of the lithium retained in the residual pulp. Even so, a closed white water system for the papermaking process to produce low-lithium IPC-1478 paper may be improved if a suitable step were placed in series to remove fines.

Experiments are under way on Project 3101-1 to try to determine the accessibility of the lithium in both the fines and the residual pulp from Series N paper.

IPC-1478 PAPER. AIR-FLOW AND RETENTION EFFICIENCY TESTS

Selected samples of purified IPC-1478 paper were sent to Knowlton Brothers where, under the supervision of Dr. Grant Rauscher, air-flow and particle retention efficiency tests were obtained. The results as supplied by Dr. Rauscher are placed in Appendix I of this report; a copy was sent to Jack Phelps at MCL-C, McClellan AFB.

The results indicate no significant changes in the air-filtering characteristics due to the purification procedures.

FUTURE WORK

1. Eight rolls of Series N paper have arrived at the Institute. Five rolls (about 500, 19-inch squares) will be processed into purified paper.

2. Experiments are in progress to test the accessibility and the exchangeability of lithium using lithium-6. Previous results were inconclusive and need verification.

3. Experiments are in progress to test the accessibility of lithium in exhaustive leaching with water by (a) capillary movement and (b) by percolation.

EXPERIMENTAL

372, 374, 386, 406, 409, 410, 423, 425, 426. PURIFICATION OF SERIES N PAPER, 19-INCH SQUARES

Stacks of 19-inch squares, 120 sheets from each of four rolls, were leached by percolation in succession with the following solutions in each of two cycles.

15 liters 0.1M hydrofluoric acid

15 liters deionized water

15 liters 0.1M ammonium carbonate

15 liters deionized water

15 liters 0.1M hydrofluoric acid

55 liters deionized water

The stack was pressed under a rubber sheet by a partial vacuum (water aspirator pump) to a consistency of 20-25% and the sheets were dried in a stream of filtered air at room temperature. The leaching steps required approximately 5 hours, except when the extended schedule of 8 days was used. In the latter case, a total of 95 liters of deionized water was used to wash the paper in portions of 25, 30, 20, and 20 liters, one portion per day on successive days, in place of one 55-liter portion.

Kronisol was applied from a small paint sprayer (2) or from a perforated polyethylene (PE) bottle at a rate of 30% based on the weight of the untreated, airdry paper.

The PE bottle (500-ml, screw-capped) was perforated with a needle (0.7 mm in diameter) in a narrow band, 5 mm in width, top-to-bottom, on the cylindrical part of the wall, only. Approximately 150 holes formed the perforated zone. The bottle was filled half or two-thirds full of Kronisol, the perforated zone was placed in contact with the paper and, using quick, even strokes (with a light pressure by hand on the bottle) Kronisol was applied as evenly as possible to each sheet. Each sheet was weighed (but not recorded) to monitor the addition of Kronisol. Analytical samples and the finished paper were assigned the numbers shown in Table I.

380-384. PURIFICATION OF IPC-1478 PAPER, SERIES N, BY LEACHING INTACT ROLLS

Rolls of IPC-1478 paper, Series N, were provided by the laboratory at McClellan AFB. Each roll (10 inches by 80 feet) was wound on a length of PVC sewer pipe (3-1/2 inch OD) to minimize contamination. With the roll in a horizontal position in the leaching tray, it was leached by percolation with 4 liters each of the following reagents in succession:

a. 0.1M hydrofluoric acid
b. deionized water
c. 0.1M ammonium carbonate
d. deionized water
e. 0.1M hydrofluoric acid
f. deionized water.

The roll was pressed under a rubber sheet, was draped in an accordion fold on a drying rack, and was dried for 24 hr in a stream of filtered air at room temperature. Samples for analysis were removed near each end of the dry strip of paper, the remainder was rewound, and the leaching cycle was repeated. The data are summarized in Table II.

385A to Y. LIMITED LEACHING OF IPC-1478 PAPER, SERIES N

A stack of 100, 17-centimeter squares of Series N paper (Roll 22) was placed on the leaching platform and deionized water in small portions was poured onto the stack. By percolation and capillary movement, just sufficient water (1300 ml) was used to wet the stack. Without pressing, the stack was separated into sets of four sheets and the sets (A to Y) were dried in a stream of filtered air at room temperature. The analysis of selected samples is listed in Table II.

399-402. ATTEMPTED PURIFICATION OF IPC-1478 PAPER BY CAPILLARY MIGRATION OF LEACHING AGENTS

Strips (24 cm by 110 cm) of IPC-1478 paper, Series N, Roll 22 were placed in a glass tank as commonly used for paper chromatography. One trough was all-polyethylene and the other all-glass. After approximately 1 liter of deionized water passed through the sheet by capillarity, the sheet was dried in the air (unfiltered) at room temperature. Additional strips of paper were leached with two one-liter portions of water with an intermediate drying step, and one set of strips was leached with 1 liter each in succession of 0.1M ammonium carbonate and water. Analytical data are recorded in Table II.

390 to 394, 396, 397, 403, 404, 407. HANDSHEETS MADE IN TAP WATER AND IN DEIONIZED WATER

Hercules cotton linter pulp, PS-57, was dispersed in tap water (Appleton city water, pH 9.6) in a British Disintegrator[3] at the rate of 40 g airdry pulp in 2 liters of water. The disintegrator was operated for 5 min

[3]See footnote p. 9.

(600 counts, 15,000 revolutions of the stirrer) for each 40-g batch of pulp. Four 40-gram batches were combined and diluted in a stainless steel tank to a total volume of 32 liters, 0.5% consistency. For each handsheet, 1200 ml of the stock containing 6 g of airdry pulp, was diluted to 6 liters in a sheet mold and formed into a handsheet 8 inches square. Each sheet was couched with squares of pulp, pressed, and dried in filtered air at room temperature.

Sets of handsheets were made from tap water, washed on the sheet mold twice with 200-ml portions of deionized water and with water at pH 9 (ammonium carbonate).

Other sets of handsheets were made from purified pulp (341) in tap water and in deionized water.

The analytical data are listed in Table III.

413-422. RECOVERY OF FINES FROM SERIES N PAPER

The scrim was removed from 250 g of Series N paper which was then dispersed in 25-g batches in a British Disintegrator[4]. Each 25-gram batch was stirred for 5 min (600 counts, 15,000 revolutions of the stirrer) in deionized water adjusted to pH 9 with ammonium carbonate, the slurry was poured into a plastic funnel with a plastic screen septum, the pulp pad was redispersed in an additional 2 liters of water at pH 9, and the slurry was poured again into the plastic funnel. The pulp pad was pressed under a rubber sheet at reduced pressure (water aspirator pump) and dried. A tared circle of purified pulp (341) was placed on the funnel and the 4 liters of white water combined was

[4]See footnote p. 9.

filtered through the circle of pulp to collect the fines. The circle was not washed or pressed before drying. The process was repeated except that the same tared circle of pulp was used for the collection of the fines thereby combining the fines from 50 g (excluding scrim) of the original Series N paper.

Four additional 50-g lots of the Series N paper were processed by the above procedure using recycled filtrates from the fines filtration step. Analytical data are summarized in Table IV.

LITERATURE CITED

1. Project 3101-1, Report Sixteen, p. 3.

2. Project 3101, Report Fourteen, p. 33.

3. Project 3101-1, Memorandum dated August 23, 1974, from E. Dickey to Swanson, Pearl, Wollwage, Smith, Dickey, p. 3.

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APPENDIX

AIR TEST DATA FOR SELECTED SAMPLES
No. 3101- 365, 366, 376, 378, 426, 409, 425, 428, 430

These tests were performed on the USAF tester at Knowlton Brothers, Inc., Watertown, NY, and reported by letter dated February 24, 1975, from Dr. Grant K. Rauscher to E. E. Dickey and to Jack Phelps.

J[illegible]C - 1478 Paper (KB 107) IPC Series 3101

SAMPLE NO. OR LOT NO.	PRESSURE DROP INCHES OF WATER LEFT MAN 1.25" ORIFICE	AIR VELOCITY FT/MIN. THRU SPECIMEN	PRESSURE DROP INCHES OF WATER ACROSS SPECIMEN RIGHT MAN.	UPPER CELL CLEAN AIR * A	UPPER CELL DUST LADEN AIR NO SPEC-IMEN B	LOWER CELL CLEAN AIR * C	LOWER CELL DUST LADEN AIR NO SPEC-IMEN E	UPPER CELL DUST LADEN AIR WITH SPEC-IMEN G	LOWER CELL DUST LADEN AIR WITH SPECI-MEN F	RETEN-TION %
365	4.8	2350	30	35	98	35	98	98	38	95.2
366	4.3	2225		30		35			38	95.2
376	4.7	2325		28		35			37	96.8
378	4.4	2250		28		35			37	96.8
426	5.6	2550		29		35			38	95.2
426	4.7	2325		33		36			38	95.2
426	4.1	2175		30		36			38	96.8
409	4.3	2225		33		36			39	95.2
409	5.1	2425		33		37			39	96.7
409	5.8	2600		31		36			39	95.2
425	5.3	2475		33		36			39	95.2
425	5.3	2475		31		36			39	95.2
425	4.8	2350		32		37			39	95.1

Continued Page -2-

* Due to contamination of air, paper No. IPC 1478 (or equivalent) should be inserted in sample holder.

I PC - 1[illegible] Paper (KB 107) IPC Series 3101

SAMPLE NO. OR LOT NO.	PRESSURE DROP INCHES OF WATER LEFT MAN 1.25" ORIFICE	AIR VELOCITY FT/MIN. THRU SPECIMEN	PRESSURE DROP INCHES OF WATER ACROSS SPECIMEN RIGHT MAN.	UPPER CELL CLEAN AIR * A	UPPER CELL DUST LADEN AIR NO SPECIMEN B	LOWER CELL CLEAN AIR * C	LOWER CELL DUST LADEN AIR NO SPECIMEN E	UPPER CELL DUST LADEN AIR WITH SPECIMEN G	LOWER CELL DUST LADEN AIR WITH SPECIMEN F	RETENTION %
428	4.7	2325	30	32	98	37	98	98	39	96.7
428	5.1	2425		31		37			40	95.1
428	4.6	2300		32		37			40	95.1
430	4.7	2325		29		37			40	95.1
430	4.6	2300		31		37			40	95.1
430	4.6	2300		35		37			39	96.7
430	5.0	2400		35		38			40	96.7

* Due to contamination of air, paper No. IPC 1478 (or equivalent) should be inserted in sample holder.